

Measuring End Results of Rehabilitation of Patients with Stroke

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REHABILITATION is that part of medical care which aims primarily to relieve the disability produced by disease and to restore the person to a place in society. The basic defect to be corrected by physical medicine and rehabilitation is disability, which prevents performance of the person's usual functions. However, we have no generally accepted measure of disability. Consequently, rehabilitation workers have been slow to convince other health personnel that their methods are effective (1).

Disability usually entails physical, mental, and socioeconomic problems, and for this reason complex measures which assess two or all three aspects have been attempted. Since 1955 the State of Maryland's three chronic disease hospitals have used a scoring method to evaluate the performance of independent movement by long-term patients. This disability score, usually called the Barthel index (2) and occasionally the Maryland disability index (3), assigns 0, 5, 10, or 15 points to performing each of 10 activities of daily living. The sum of these scores is 100 points when all activities are carried out skillfully and independently (table 1).

The Barthel index is an empirical score developed by a physical therapist and physiatrist. It provides a simple method for evaluating the physical functioning of a disabled patient at a

given time and for assessing change in physical function. The physical therapist and physiatrist discussed with nurses and physicians the physical, mental, and social importance of each activity to the patient and its importance in reducing the need for care. They decided not to refine scores for specific functions to values of less than 5 points. However, instructions were standardized to clarify the criterion of performance for each score and to improve repeatability (2).

Patients scoring 100 points could have abilities ranging from barely being able to perform the activities of daily living to being able to earn a salary in skilled employment. Therefore patients can continue to improve after scoring 100 points. Similarly, the patient scoring 0 can emerge from a coma and be conscious though helpless in bed without a change in his score.

Although abilities of patients with scores at either end of the scale can vary considerably, the functioning of patients with identical intermediate scores differs less. The lower the patient's score, the more severe is his physical impairment; a rise in score indicates an improvement in his physical functioning. The purpose of the analyses described in this paper is to assess the validity of the Barthel index. (Data for this study were made available by the staff of the Montebello State Hospital, Baltimore, Md.)

The 1,223 patients in this study all had at least one cerebrovascular accident before their

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admission to Montebello State Hospital in Baltimore during the period 1956-64. The average age of these patients was 63.8 years; white persons outnumbered nonwhite, white women were more numerous and older than white men, and nonwhite persons were younger than their white counterparts (table 2). Nonwhite patients were also poorer than white patients.

Admission Score and Mortality

Using widely accepted methods of classifying disability, Goldfarb and associates have shown that death rates increase as disability becomes more severe (4). When heart disease patients are placed in classes I through IV according to criteria set by the New York Heart Association (5), class I patients have the lowest mortality; class II patients have lower death rates than the increasingly disabled class III and IV patients (6). The correlation of mortality with classification was used to test the validity of the disability scores for patients who had cerebrovascular accidents.

Of the 1,223 patients admitted to the center during the 9 years, 1,025 received initial scores on admission. The remaining 198 patients either died before scores were assigned or were not given scores because they were regarded as poor candidates for rehabilitation.

The unscored group was older, more seriously disabled, and had a higher mortality than those receiving scores. Information about mortality was obtained from the rehabilitation center and from the files of death certificates issued by the City of Baltimore and the State of Maryland. The files were searched systematically through June 30, 1965.

Mortality did indeed fall as the patients' initial scores rose (table 3). The inverse relationship between scores and mortality was consistent whether it was derived from the numbers of patients who (a) died within 6 months, (b) were dead when discharged, or (c) died before June 30, 1965. The average period of followup for patients who were alive or dead on June 30, 1965, was 47 months.

Response to Hospital Care

Severe disability portends more than high mortality. Like persons with heart disease (7), patients severely disabled by stroke are less re-

Table 1. Barthel index (Maryland disability index)

Activity	Score (points) when activity is performed—	
	With help	Independently
Feeding ¹ -----	5	10
Moving from wheelchair to bed and return (includes sitting up in bed)-----	5-10	15
Personal toilet (wash face, comb hair, shave, and clean teeth)-----	0	5
Getting on and off toilet (handling clothes, wiping self, and flushing toilet)---	5	10
Bathing self-----	0	5
Walking on level surface-----	10	15
If unable to walk, propel wheelchair ² -----	0	5
Ascend and descend stairs-----	5	10
Dressing (includes tying shoes and closing fasteners)----	5	10
Controlling bowels-----	5	10
Controlling bladder----	5	10

¹ If food must be cut up, the patient is scored as needing help.

² Score only if unable to walk.

sponsive to rehabilitation than others whose functioning is slightly or moderately impaired. To reduce the effect of race as a possible variable in the statistical data on the outcome of care, I correlated the initial scores of white patients with their response to rehabilitation as assessed by the physician who discharged each patient (table 4).

Of 869 white patients discharged by June 30, 1965, a total of 738 had received disability scores when admitted to the center. Data in table 4 confirm the expectation that the lower their initial scores, the fewer the patients discharged as clinically improved. Thus 36 percent of the patients who scored 0-15 points at the time of their

admission and 77 percent of those with initial scores of 60-100 had improved when discharged.

Length of Stay

It would be expected that the more seriously disabled patients would stay longer in the rehabilitation center. However, the fact that this group also has a high death rate would also affect the length of their stay. These possibilities are examined in table 5.

When only patients discharged alive are considered, those with initial scores between 0-15 stayed about 26 weeks, no longer than patients scoring 20-35. As the initial scores rose further, however, the average stay fell to a minimum of 19 weeks for patients scoring from 60 to 100 points.

The average stay for all patients showed a more conflicting pattern, mainly from the numerous early deaths in the most disabled group. Deaths of patients with higher scores usually occurred many weeks after admission. In this rehabilitation center, a deteriorating patient often stayed until he died, and therefore could have a longer average stay than the patients discharged alive.

Disability and Age

It is generally recognized that older patients who have had a stroke are more disabled when admitted than younger patients. A valid disability score should reflect this situation. Average scores of persons newly admitted to the center show that older patients, regardless of sex or race, had lower scores (table 6). In addition,

Table 2. Age, sex, and race of 1,223 patients admitted with cerebrovascular accidents to Montebello State Hospital, 1956-64

Race and sex	Patients ¹	Percent in age group			
		Under 55 years	55-64 years	65-74 years	75 years and over
White men.....	439	21. 7	31. 5	30. 6	16. 2
White women.....	492	14. 7	22. 1	39. 7	23. 5
Nonwhite men.....	152	23. 9	45. 0	22. 5	8. 6
Nonwhite women.....	140	28. 1	34. 5	25. 2	12. 2

¹ Includes 6 patients whose ages were unknown. The average age for all groups was 63.8 years; 63.3 years for white men, 66.3 years for white women, 60.3 years for nonwhite men, and 60.8 years for nonwhite women.

Table 3. Initial disability scores of 1,025 patients with cerebrovascular accidents admitted to Montebello State Hospital, 1956-64, by subsequent mortality

Initial scores ¹ (points)	Patients ²	Patients dead—					
		6 months after admission		When discharged		June 30, 1965 ³	
		Number	Percent	Number	Percent	Number	Percent
0-10.....	131	39	29. 8	50	38. 2	79	60. 3
15-25.....	189	33	17. 5	51	27. 0	97	51. 3
30-40.....	235	20	8. 5	40	17. 0	101	43. 0
45-55.....	213	13	6. 1	18	8. 5	82	38. 5
60-75.....	131	4	3. 1	7	5. 3	43	32. 8
80-100.....	126	6	4. 8	7	5. 6	28	22. 2

¹ Average score of study group was 42.5.

² Excludes 198 patients not scored.

³ Giving an average followup of 47 months.

women tended to have lower scores than men of similar age and nonwhite patients scored lower than those who were white.

Rise in Score by Clinical Impression

The condition of each patient discharged alive from the rehabilitation center was classified by a physician as improved, unchanged, deteriorated, or unknown. These value judgments by the clinician who discharged the patient involved consideration of change in physical function as well as of other factors. If the disability score is valid, a greater overall increase in score should correlate well with the more frequent medical assessments of "improved." Analysis of the scores of 707 patients discharged alive indicates the greater the rise in a patient's score, the more likely he is to be classified clinically improved (table 7).

This proof of validity uses as its standard a widely accepted assessment, namely clinical im-

pression. We must recognize that errors occur in clinical impressions, and that the change in score may sometimes be more correct than the physician's classification.

In examining selected cases where the change of score disagreed with the clinical impression, the most common cause of conflict was the patient's mental deterioration which the physician regarded as more important than physical improvement. Next most common were those cases in which the records confirmed the patient's physical improvement, but the clinician seemed to give more weight to an unchanged basic medical prognosis.

In a few cases a large improvement in score was recorded. However, I found that the patient's condition had deteriorated shortly before he was discharged, and a new disability score had not been calculated. Without these deviations the agreement between higher scores and clinical improvement would have been much closer than the data in table 7 suggest.

Table 4. Initial disability scores and outcome of rehabilitative care of 738 white patients with cerebrovascular accidents discharged from Montebello State Hospital by June 30, 1965

Initial scores (points)	Alive		Improved ¹		Unimproved ¹		Dead		Total ²
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
0-15-----	87	63.0	49	35.5	38	27.5	51	37.0	138
20-35-----	151	75.5	122	61.0	29	14.5	49	24.5	200
40-55-----	182	87.1	156	74.6	26	12.4	27	12.9	209
60-100-----	180	94.2	147	77.0	33	17.3	11	5.8	191

¹ As assessed by the physician who approved the discharge.

² Omits 131 patients not scored when admitted.

Table 5. Initial disability scores of 738 white patients discharged from Montebello State Hospital by June 30, 1965, by average weeks of stay

Initial scores (points)	Alive		Dead		Total ¹	
	Weeks of stay	Average stay	Weeks of stay	Average stay	Weeks of stay	Average stay
0-15-----	2,249	25.6	965	18.9	3,214	23.3
20-35-----	3,903	25.8	1,524	31.1	5,427	27.1
40-55-----	3,987	21.9	922	34.1	4,909	23.5
60-100-----	3,421	19.0	449	40.8	3,870	20.3

¹ Omits 131 patients not scored.

Table 6. Race, sex, age, and initial average disability scores¹ (points) of 1,020 patients admitted to Montebello State Hospital, 1956-64

Patients ²	Men		Women	
	Under 65 years	65 years and over	Under 65 years	65 years and over
White:				
Number admitted.....	214	172	161	243
Average score.....	53.4	35.5	46.7	34.4
Nonwhite:				
Number admitted.....	89	36	72	33
Average score.....	50.1	32.4	44.0	35.2

¹ Average for all patients was 42.5.

² Excludes 198 persons not scored and 5 persons whose ages were not known.

Table 7. Improvement in disability scores of 707 patients discharged alive, by proportion of patients classified as clinically improved

Improvement in disability score (points)	Patients discharged alive ¹	Patients classified clinically improved	
		Number	Percent
0-5.....	108	68	63.0
10-15.....	114	89	78.1
20-25.....	125	114	91.2
30-35.....	102	96	94.1
40-45.....	114	105	92.1
50-55.....	90	88	97.8
60 or more.....	54	52	96.3

¹ Excludes 154 patients discharged alive, comprising those who received no score when admitted or discharged from the center, persons whose scores decreased, and others not classified by the physician who discharged the patient.

Early Rehabilitation and Rise in Score

Another widely accepted guideline in rehabilitation is that patients who receive care early improve more than those who delay treatment. This axiom was used as a further test of the validity of the scoring procedure. In table 8, the time between onset of disability and admission is correlated with clinical evaluations and the average increases in score.

Of the 861 patients discharged and still alive by June 30, 1965, only white patients aged 65

and older showed little change in the average rise in score. In younger white patients and all nonwhite patients the average rise in score fell with increasing delay in admission.

The proportion of nonwhite patients showing clinical improvement was unexpectedly less among those who received treatment early than among nonwhite persons admitted after longer periods of incapacity. However, nonwhite pa-

Table 8. Average rise in disability scores of 835¹ patients discharged alive, by weeks between cerebrovascular accident and admission, race, and age

Number of weeks, race, and age	Percent improved	Average rise in score ²
<i>0-8 weeks</i>		
White:		
Under 65 years.....	83.6	34.8
65 years and over.....	71.0	24.9
Nonwhite, all ages.....	78.7	36.8
<i>9-26 weeks</i>		
White:		
Under 65 years.....	79.4	26.7
65 years and over.....	71.0	25.7
Nonwhite, all ages.....	83.8	29.6
<i>27 weeks or more</i>		
White:		
Under 65 years.....	70.2	19.2
65 years and over.....	58.1	22.7
Nonwhite, all ages.....	82.6	22.5

¹ Omits 26 patients discharged alive for whom interval between cerebrovascular accident and admission was unknown.

² For all patients discharged alive, but not necessarily improved.

Table 9. White patients discharged to go home from Montebello State Hospital, January 1, 1956, to June 30, 1965

Sex and discharge score (points)	Discharged alive ¹	Went home	
		Number	Percent
Men:			
70 or less.....	89	53	59.6
75 or more.....	184	158	85.9
Women:			
70 or less.....	115	67	58.3
75 or more.....	165	131	79.4

¹ Omits 86 patients whose score when discharged was unknown.

tients admitted to the center within 8 weeks of their stroke had a higher average rise in score than any other group.

Clinical evaluations and average scores indicated that among white patients age also was a major determinant of improvement. Younger white patients, among both the early and late recipients of rehabilitative treatment, improved more than those who were older.

Being more difficult to care for at home, the more seriously disabled patients are more likely to be discharged to other institutions. White patients were more likely to go home when scoring 75 or more points on discharge than those with lower scores (table 9). These observations suggest again that the total score was a valid reflection of the physical disability.

Discussion and Conclusions

The results of this study almost uniformly suggest that the Barthel index agrees well with other independent measures of physical disability. The word "independent" is emphasized because the physicians who discharged the patients did not use the disability scores to make their final assessments. The Barthel index was originally devised to describe the physical capacity of individual patients at one moment in time (2). However, it is also a relatively accurate indicator of the disability of groups of patients and of the change in ability, both of individuals and groups.

To argue that the index was not designed for these purposes should not discourage wider use; many inventions have a wider application than their originators envisioned. To show that the index is far from ideal should not prevent its use, so long as it is more effective than previously used means of measurement. Any disability score may be misleading when the defects of the scoring system are forgotten. Major shortcomings of the index are that 0 does not represent the nadir of a patient's condition and 100 points does not reflect the upper limit of

improvement. Moreover, the index does not reflect changes in other activities inherent in disability. Kelman and Willner (8) and Gordon and associates (9) describe other problems in using scoring procedures to measure disability.

This index, or one which is shown to be better, can speed the development of new knowledge about rehabilitation by measuring one important result, a change in physical function. When used as a means for determining which patients are most likely to recover the ability to function, the index can increase the efficiency of rehabilitation programs. These improvements cannot occur, however, until a standard measure becomes widely used in the United States. I hope the experience discussed in this paper may encourage the wider acceptance of a simple measure.

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